Reliability Run-5: Cu HE vs. LE

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outline

- System reliability
- Comparison performance data HE and LE
- HE – LE parameter differences
- On performance and reliability optimization

→*discussion*

Machine reliability topic of a full session during Retreat 2002 (Mike Brennan)

System reliability

basis of system reliability:

over-design and/or ‘conservative’ use

- Not the way high-energy accelerators typically get designed (cost cutting) or used (pushing performance)
- Unlike synchrotron light sources or other applied physics machines

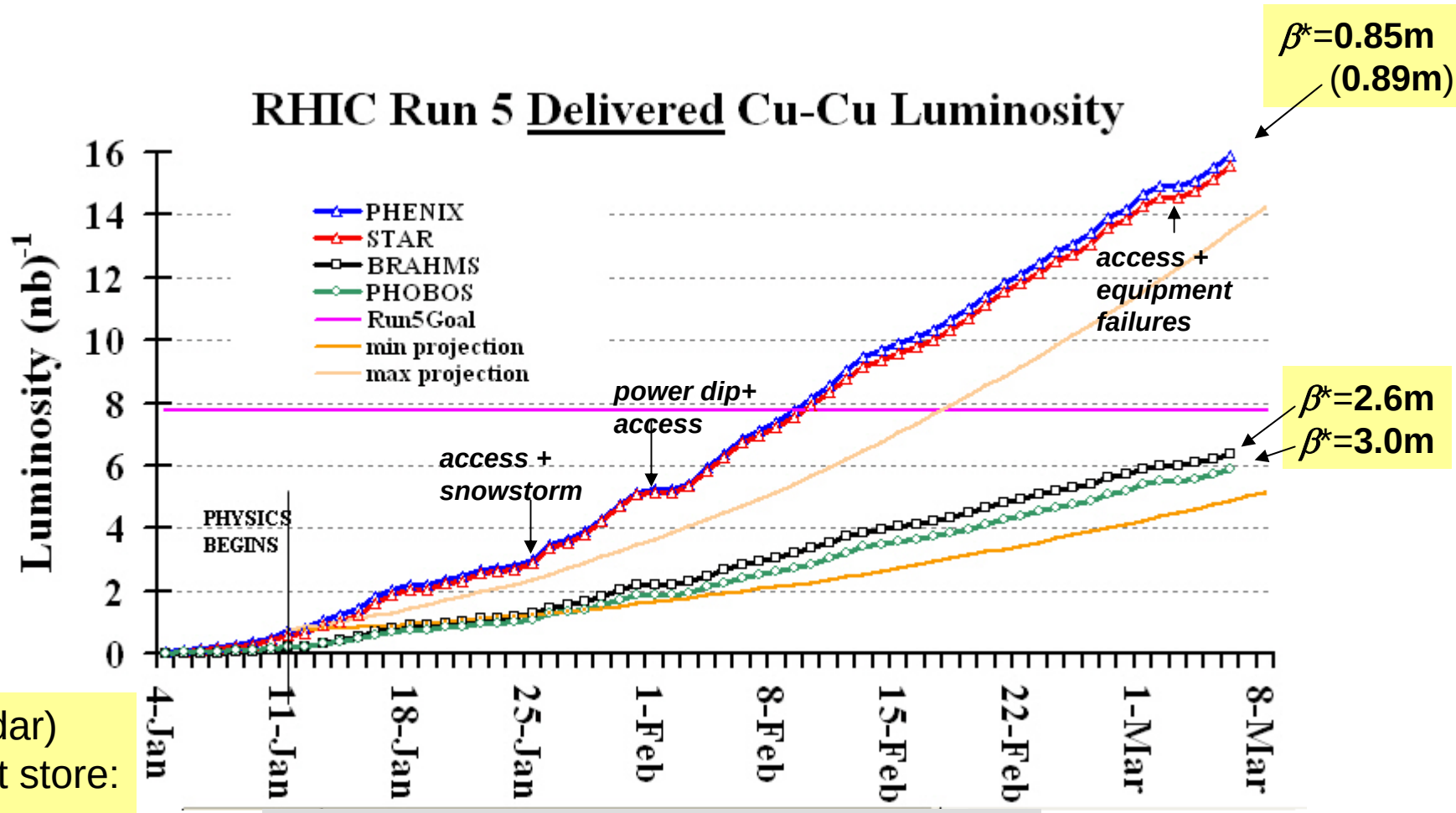
Machine reproducibility

“trivial”: do the same, machine reproduces

“non-trivial”: change parameter X and Y reproduces

(still “trivial reproducibility” issues in the run upon ramp reversal, likely caused by slow orbit shifts)

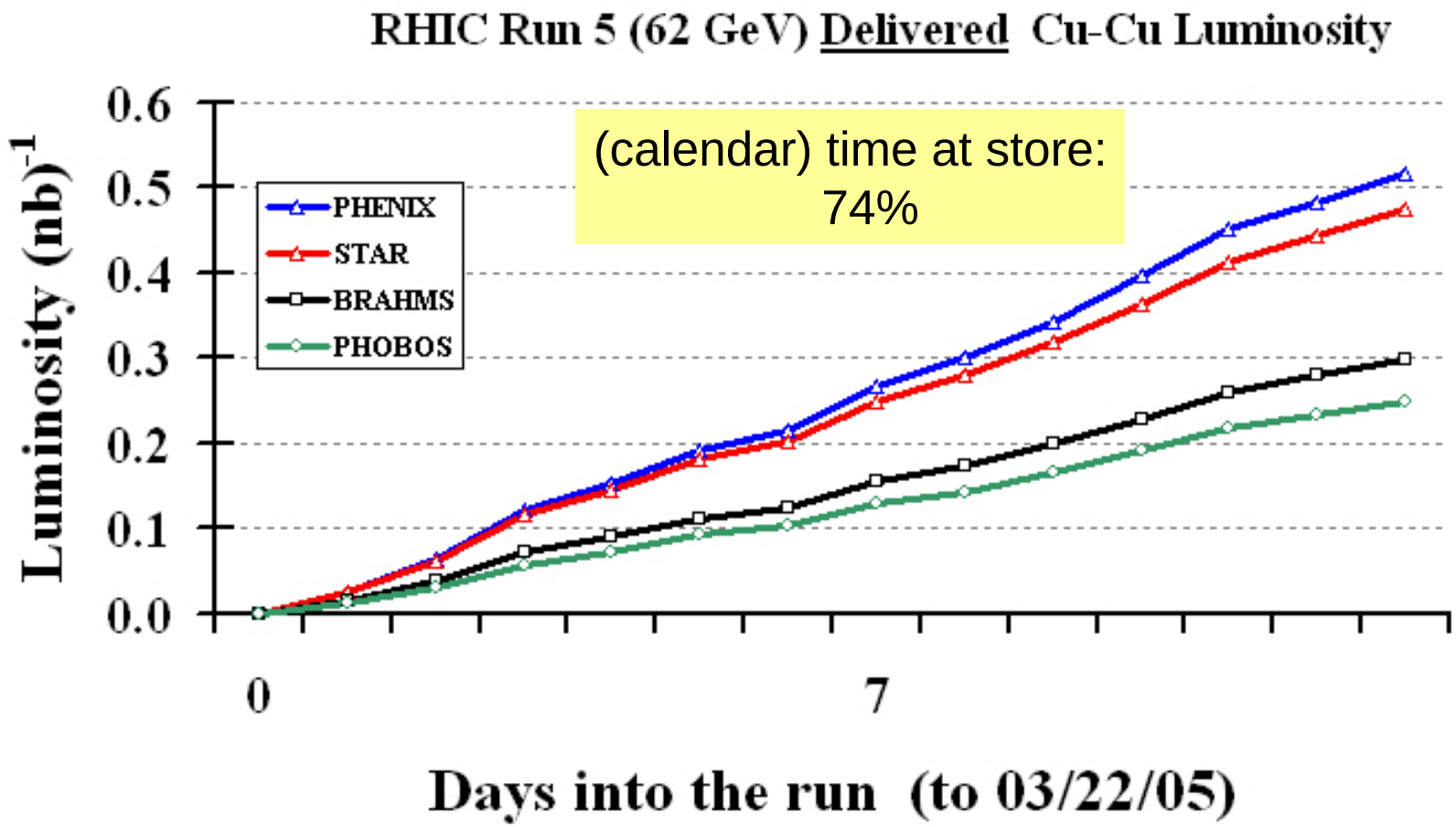
Integrated luminosity HE



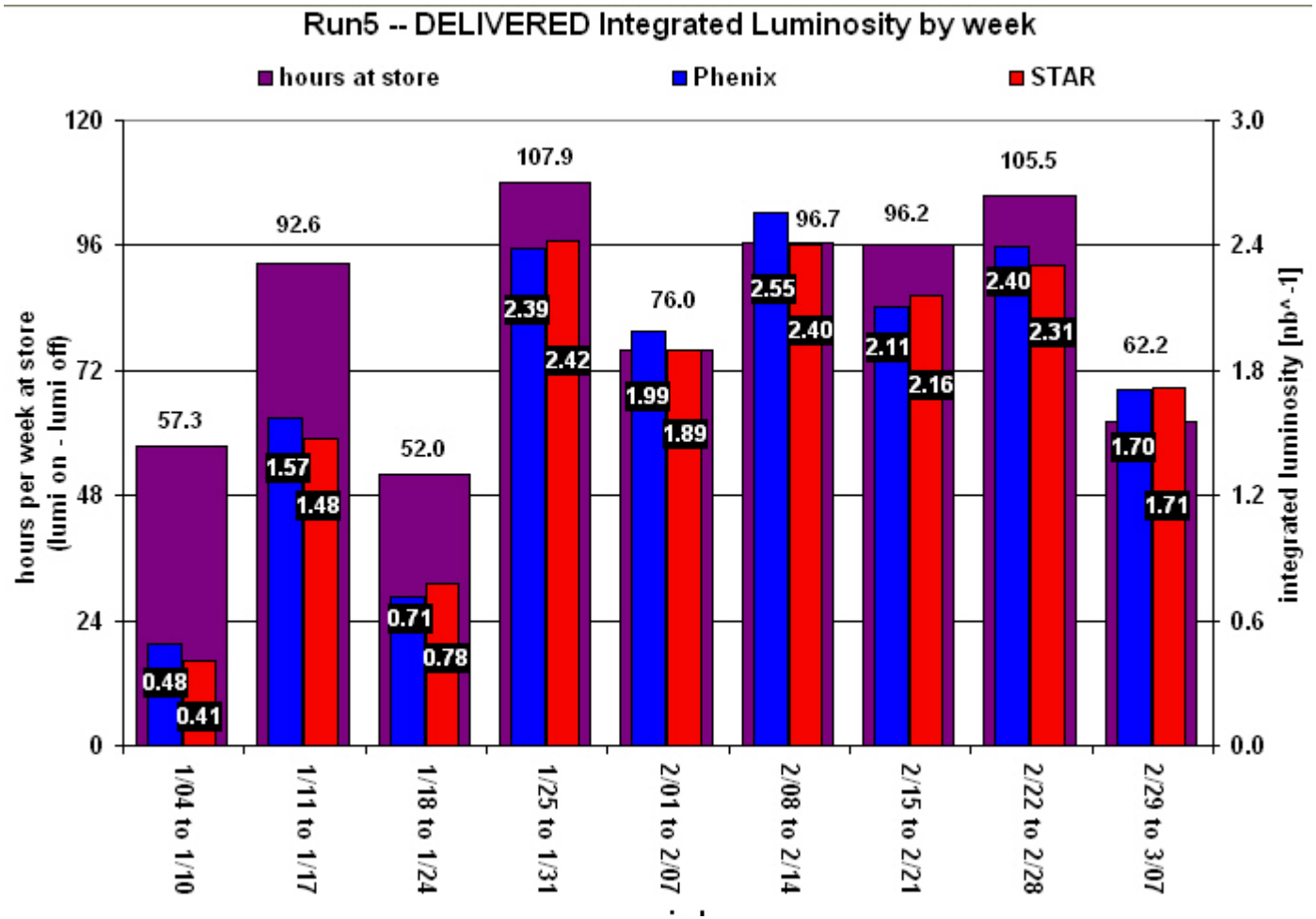
(calendar) time at store: 52%

Cu-cu cross section measured at 2.6 barn

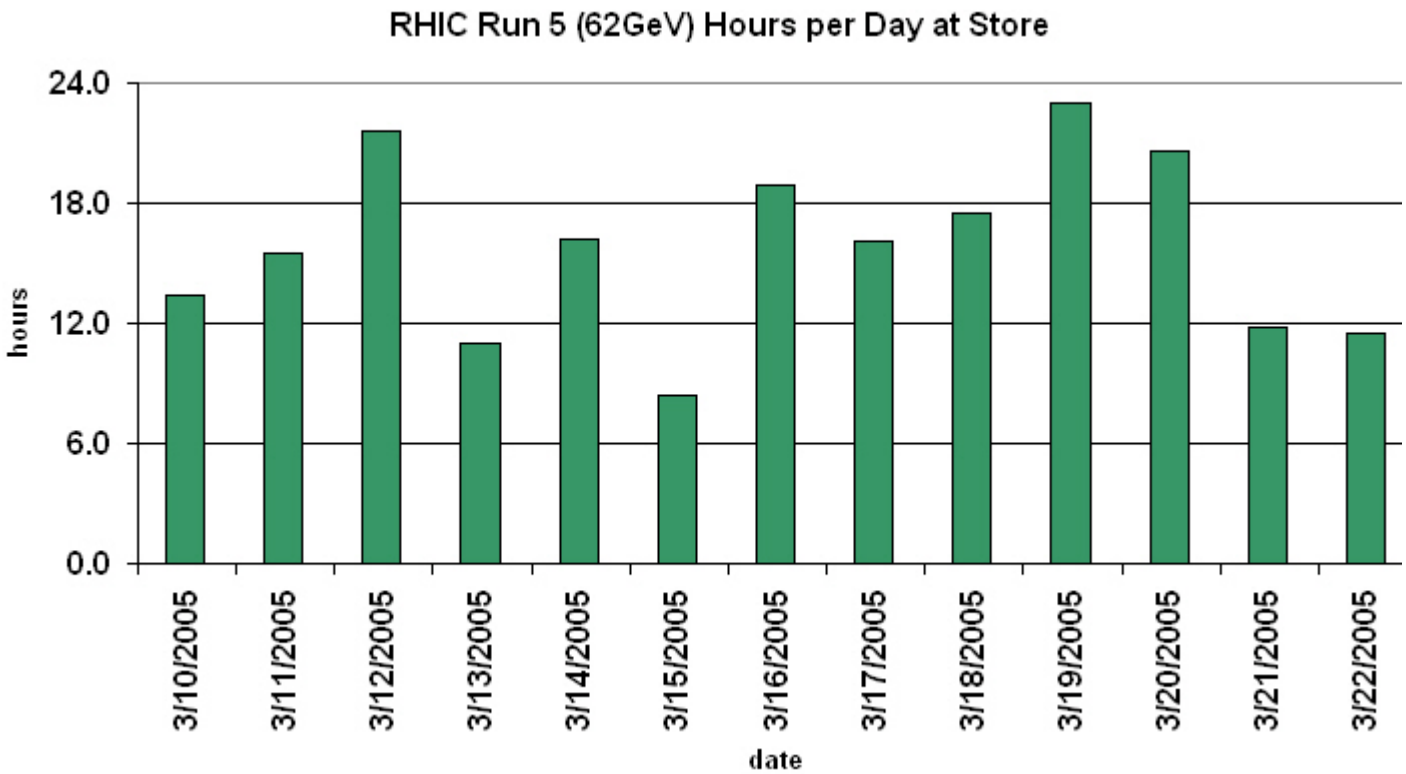
Integrated lumi LE



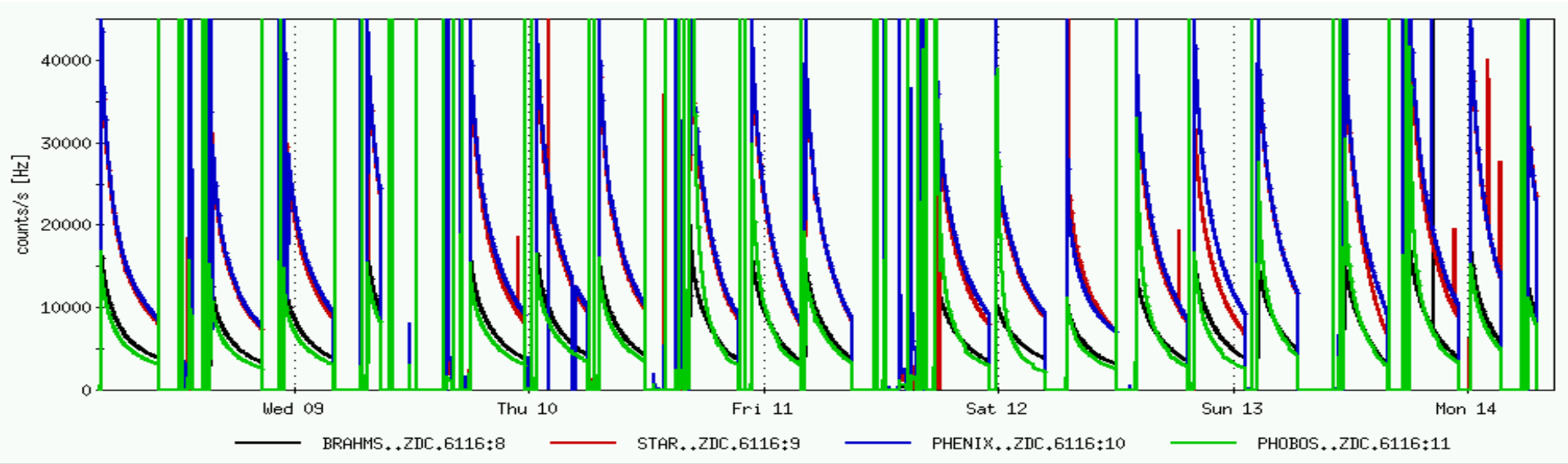
hours at store - HE

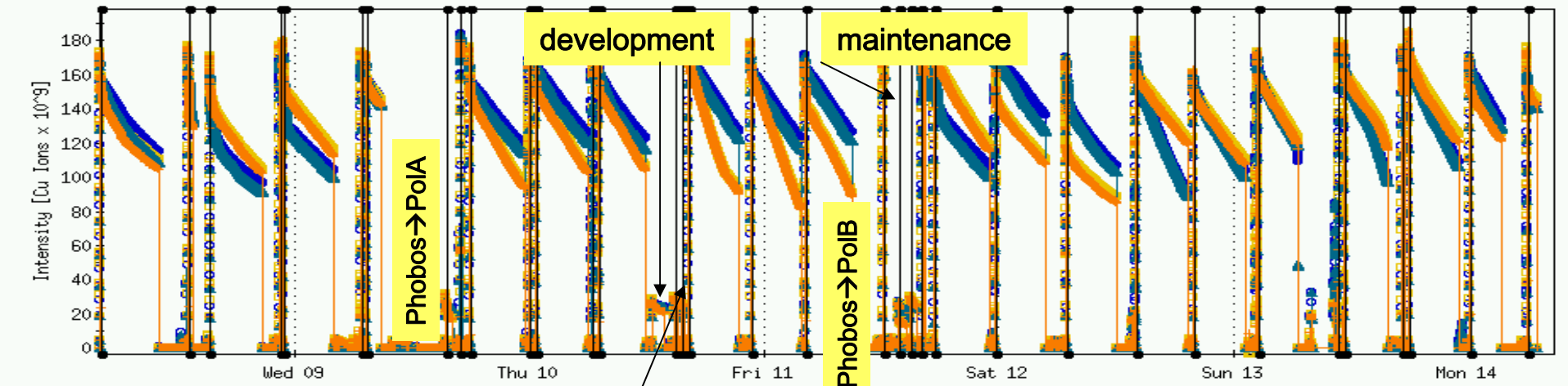


Hours at store - LE



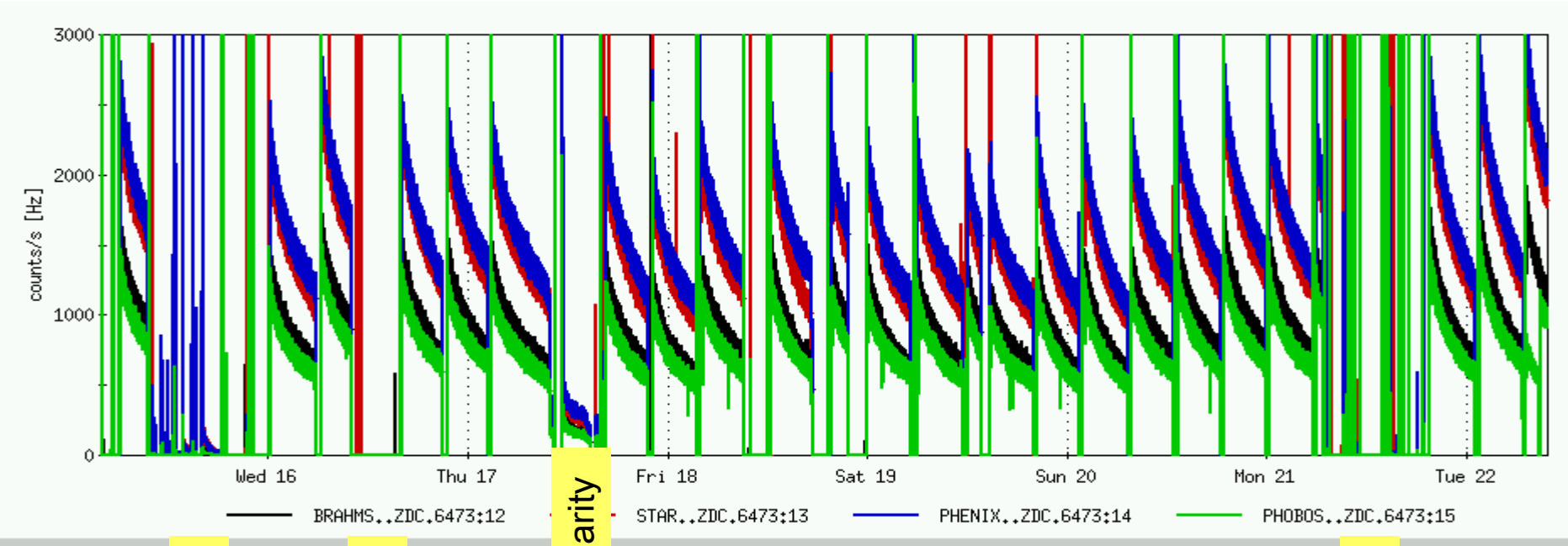
Rates, intensities – week 5

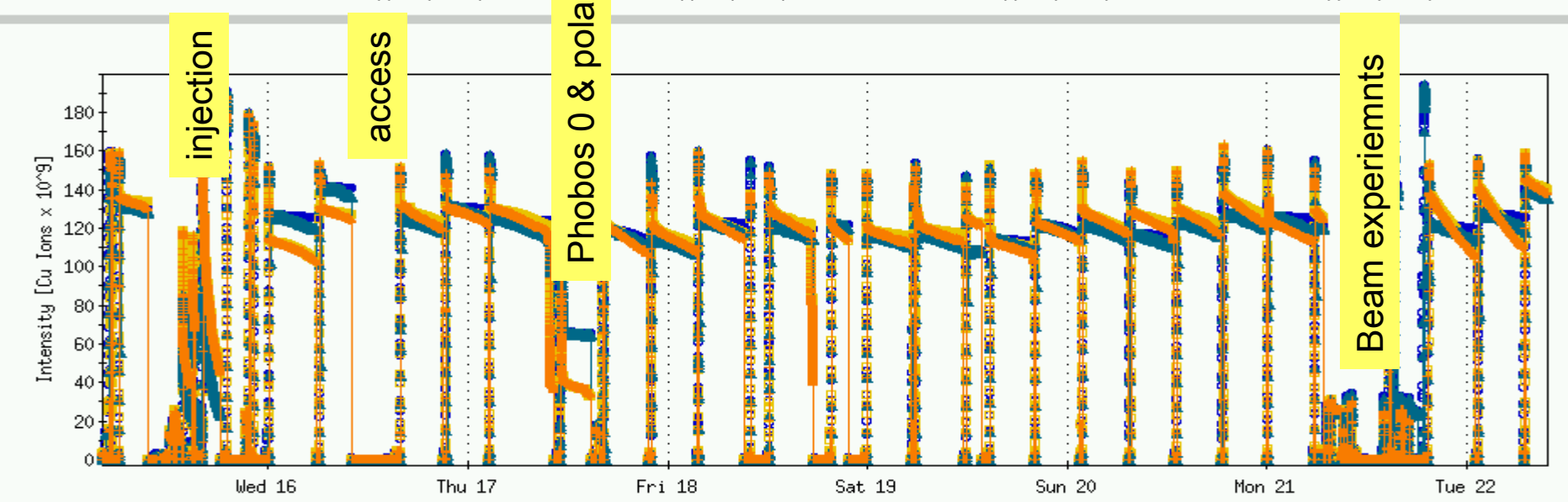




Phobos PR

LE week 2 - stores





HE vs. LE parameters

Observables

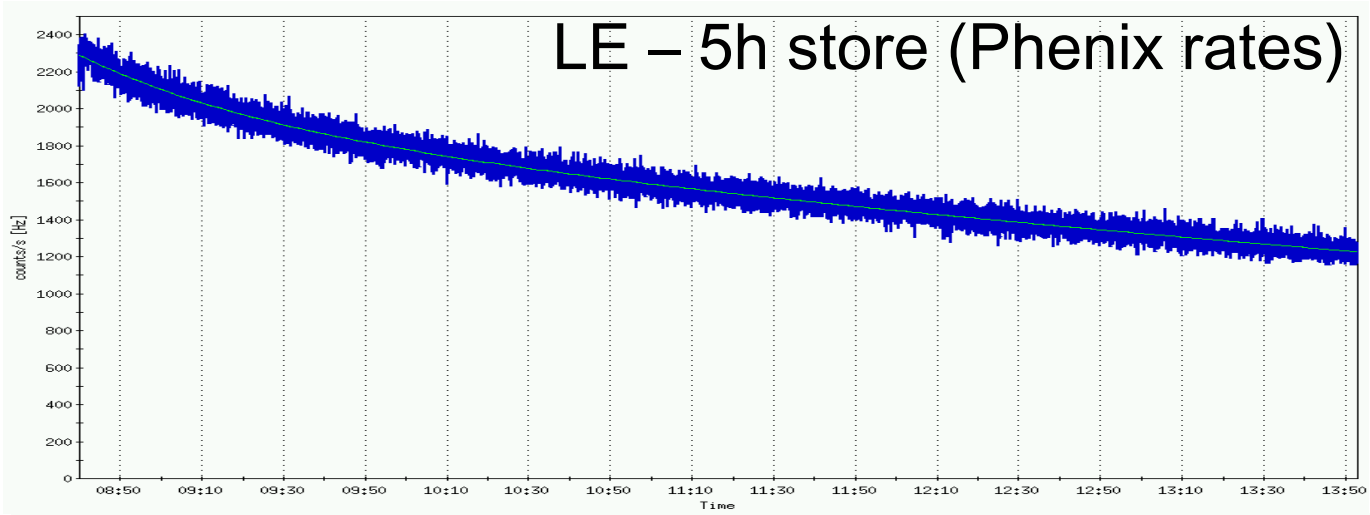
- Reproducibility
- luminosity lifetime
- time between stores

Variables: machine parameters

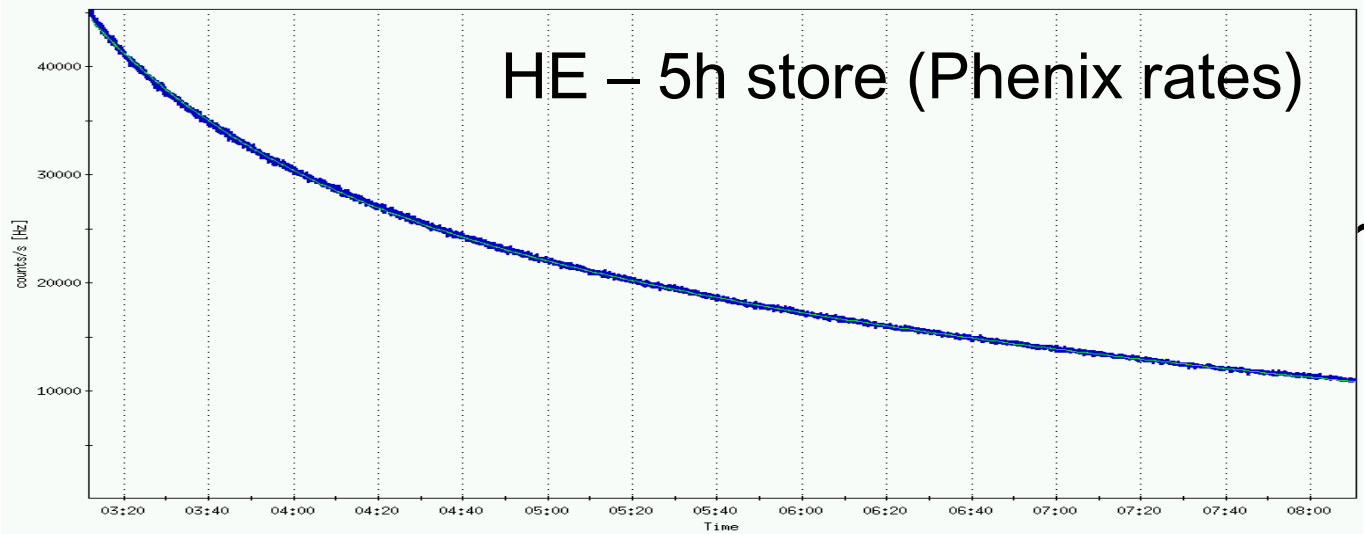
(almost the same #bunches 37-41, transmission HE~95%, LE ~ 85-92 %, same transition set-up)

- **bunch intensity**: HE 41x 4.5e9 LE: 37x3.8e9
- **beta*** HE: 0.85m LE: 3m
- **energy** HE: 100 GeV/u LE: 31.2 GeV/u

HE – LE luminosity lifetime

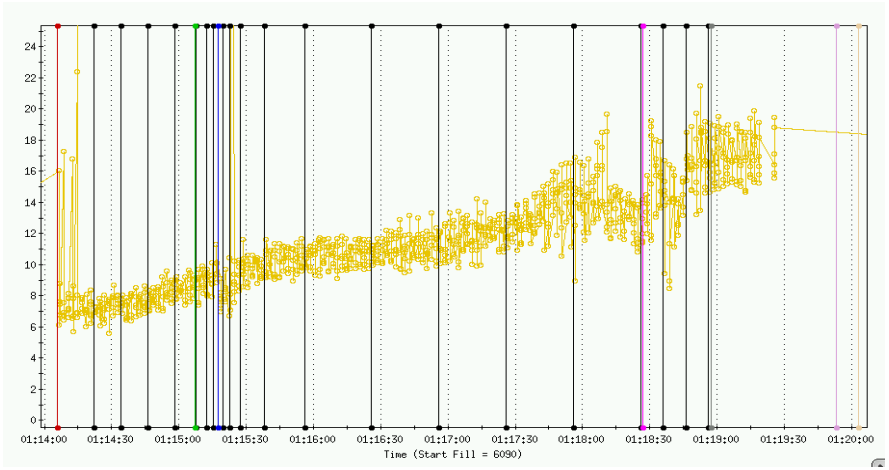


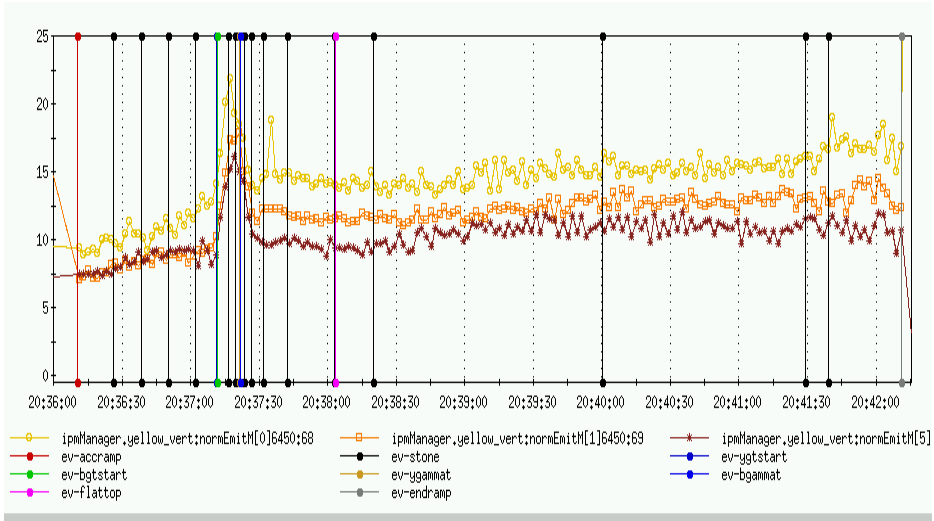
6+ hours

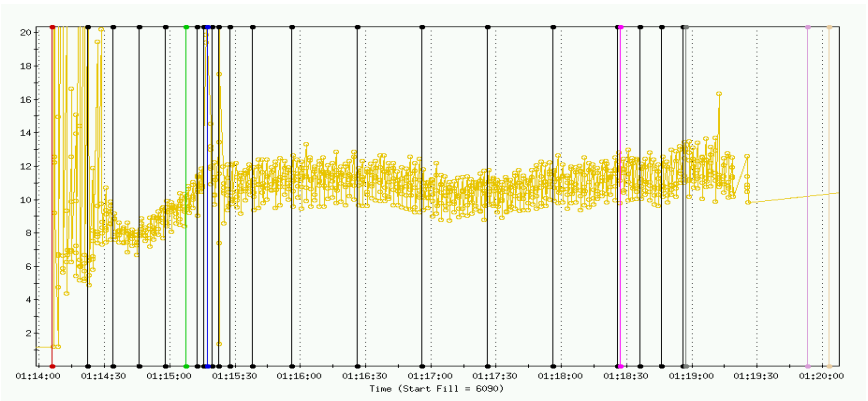


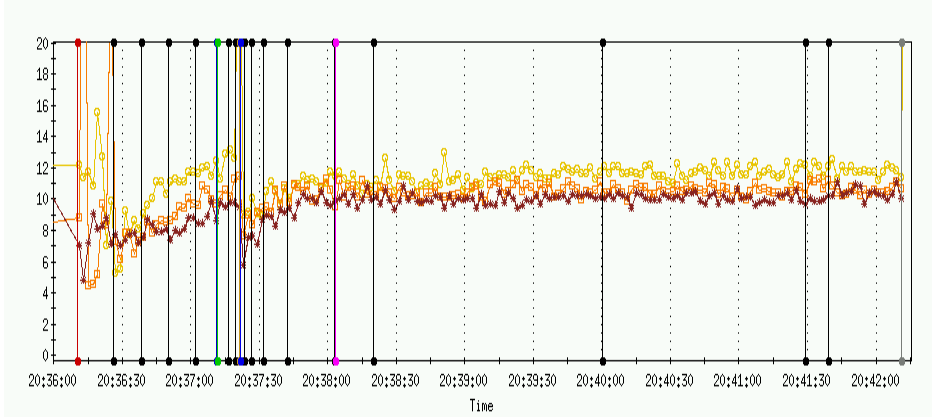
~3-3.5 h

HE vs. LE ramp: emittance

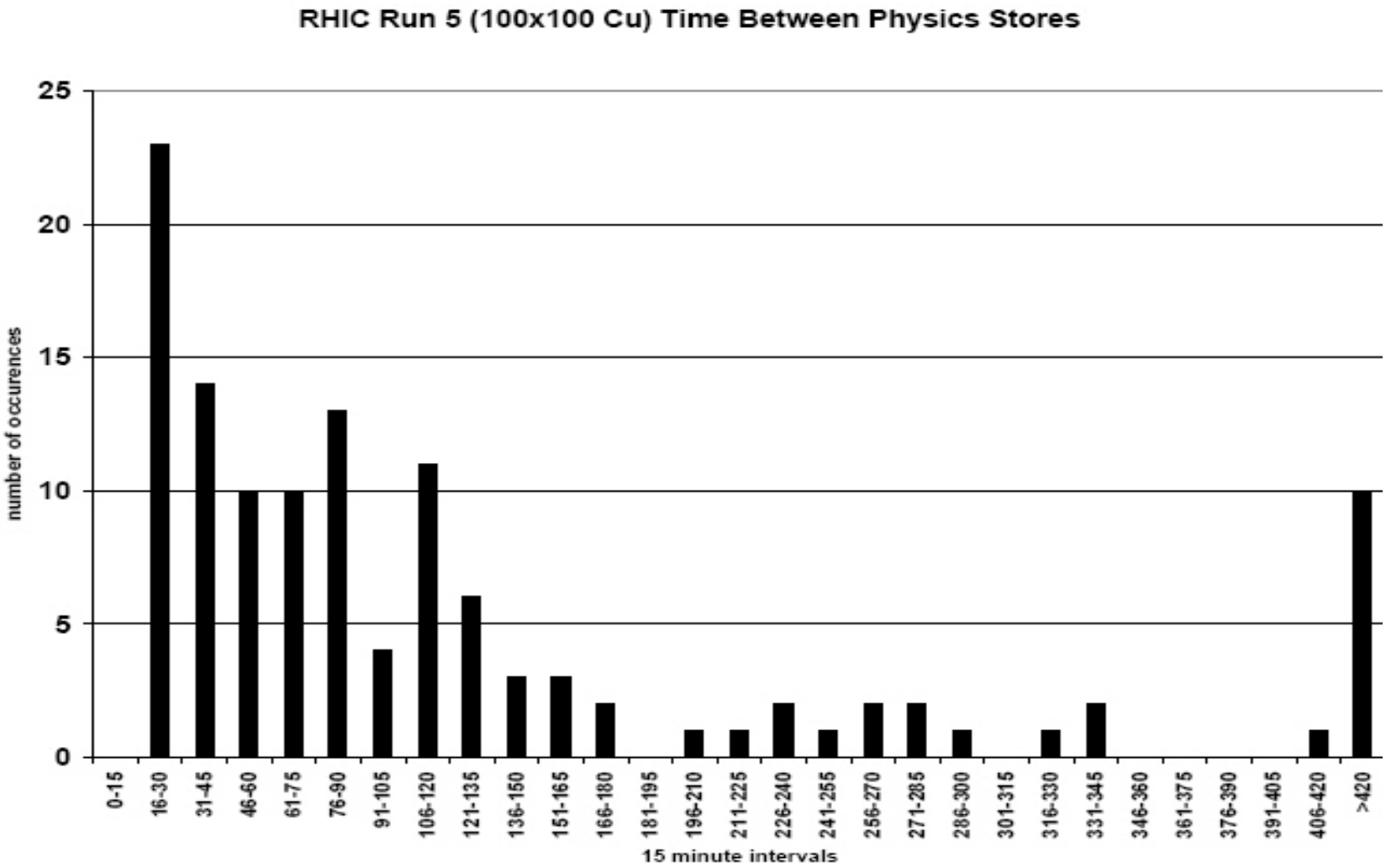




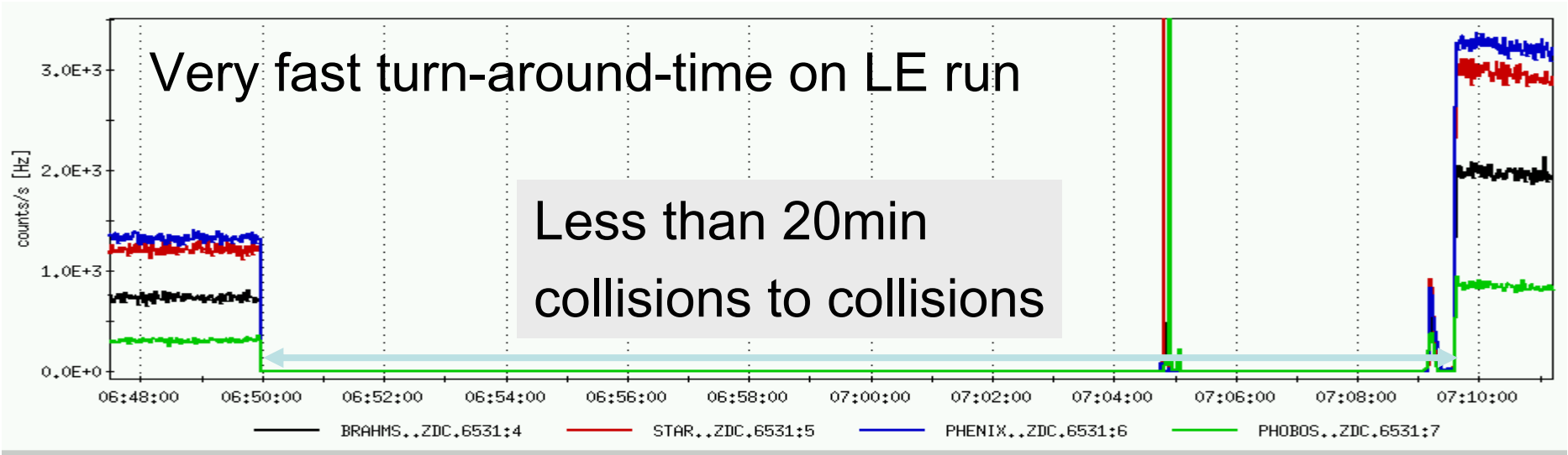


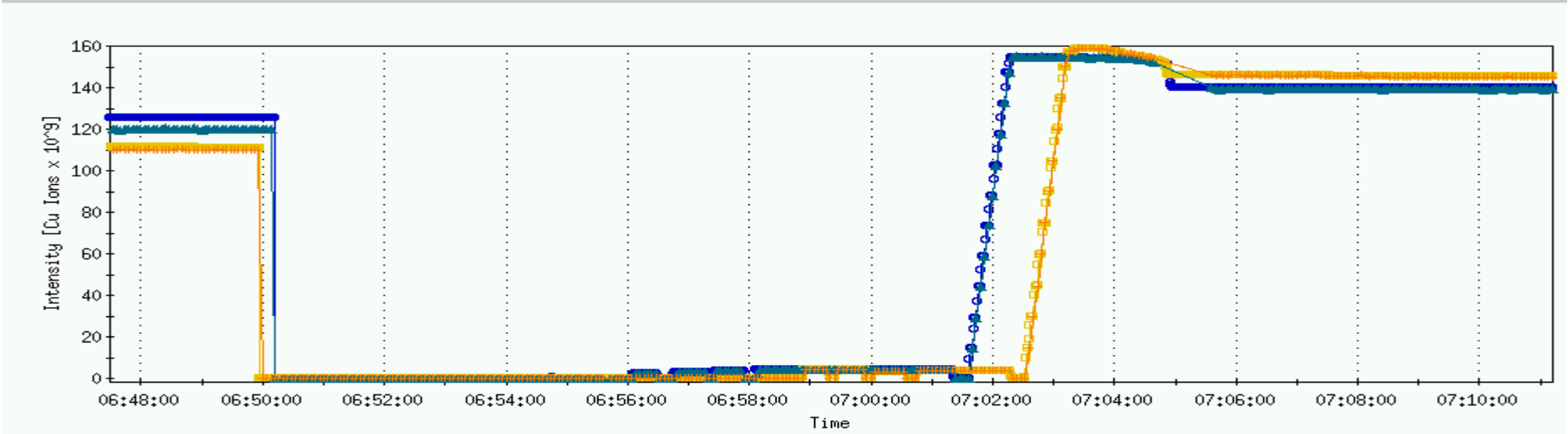


HE: time between stores



LE: store-to-store time





Reliability factors

Bunch intensity

- Losses on ramp, permit pulls
- Beam decay at store, tuning, collimation
- Beam-beam, luminosity lifetime
- single bunch instabilities
- BLAM

Beta squeeze

- Losses on beta squeeze, permit pulls
- Aperture, losses at triplets

Energy

- Shorter ramps, shorter time between stores

Integrated lumi “strategies”

- **Push bunch intensity, beta*, find limit, adjust # bunches**

  PRO’s: machine upgrade, learn to cope with limits in operations

  CON’s: low(er) uptime, no truly ‘routine operations’

- **Conservative parameters**

  PRO’s: high(er) uptime, routine operations

  CON’s: machine upgrade needs dedicated development time

→ ***Discussion at Retreat***